Department of Horticulture and Crop Science

Protein Yield Stability of Soybean Breeding Lines

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INTRODUCTION

In Africa, soybeans (*Glycine max*) are a source of protein via soymilk and soy flour. Africa currently produces ~1.5 million tons of soybeans. They import a similar amount[1].

Increased soybean production has been proposed as one component to a solution for malnutrition in Sub-Saharan Africa. Development of soybean cultivars maximizing protein production per hectare (protein yield) may contribute to the solution for malnutrition[1].

However, crop production in Africa is often limited by unpredictable environmental constraints. Thus, protein yield would need to be stable across environments.

Previous studies found that high yields are often associated with high yield instability over environments[2].

Little research on the stability of *protein* yield has been done. Therefore, as a first step in evaluating the utility of soybean cultivars with high protein yield, we are investigating the relationship between protein yield and the stability of protein yield.

AIM

This study aimed to determine the seed protein content, protein yield, and yield of 114 breeding lines and their correlations (positive, negative, or neutral) with the environmental stability of each of these traits.

Figure 1: Locations of Field Research Plots

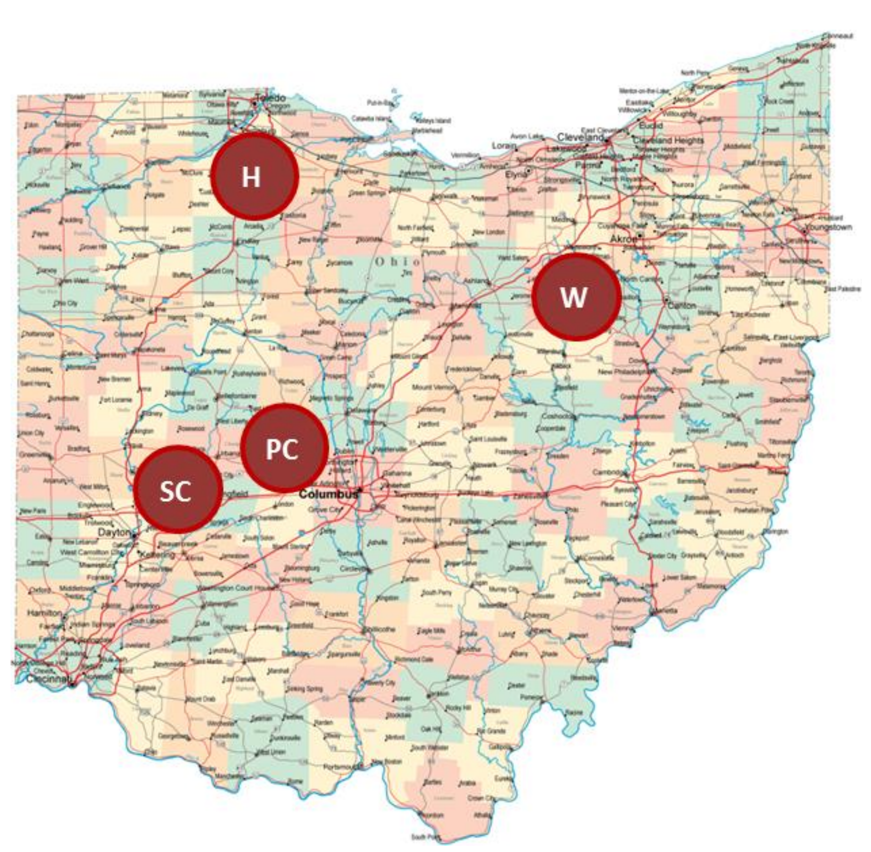

Figure 1. Three replicates of each breeding line were grown in each of the Ohio locations indicated: Plain City (PC), Hoytville (H), South Charleston (SC), and Wooster (W).

METHODS

Three replicates of 114 breeding lines were grown in Plain City, Hoytville, South Charleston, and Wooster, Ohio (Fig. 1).

The breeding lines were divided between early and late maturity groups and planted in a randomized complete block design within each group.

Seed was harvested in fall of 2014.

Protein and oil content of a sample of 100 seeds from each replicate was determined by Near Infrared Spectroscopy.

Best linear unbiased predictor (BLUP) values were calculated for each trait to represent the effects of each breeding line, each environment, and each line in each environment. BLUP values were calculated with SAS Proc Mixed[4] and the model: phenotype = experimental mean + breeding line + environment + breeding line x environment + error.

Stability indices were determined by the Eberhart-Russell regression method[3].

RESULTS

Among breeding lines, seed protein content was negatively correlated with yield (r = -0.25) and positively correlated with protein yield per hectare (r = 0.25; Fig. 2) Protein yield per hectare and yield per hectare positively correlated (r = 0.86; Fig. 2).

There were no significant (α = 0.05) correlations between any seed protein content, protein yield, yield and any of their stability indices (Fig. 3).

Figure 2: Correlations between seed protein content, protein yield, and yield

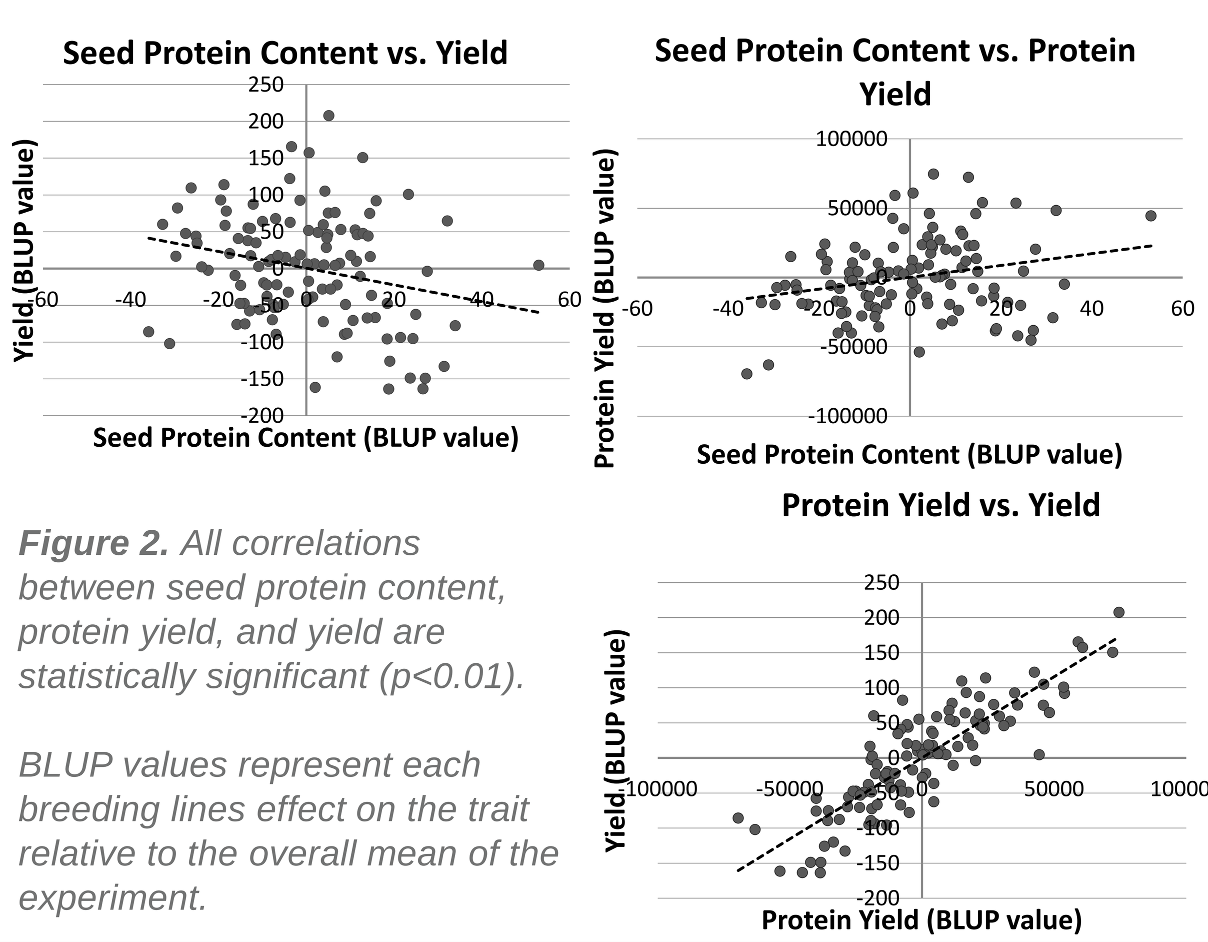

Figure 2. All correlations between seed protein content, protein yield, and yield are statistically significant (p<0.01).

BLUP values represent each breeding lines effect on the trait relative to the overall mean of the experiment.

Figure 3: Correlations between Seed protein content, protein yield, yield, and their stability indices

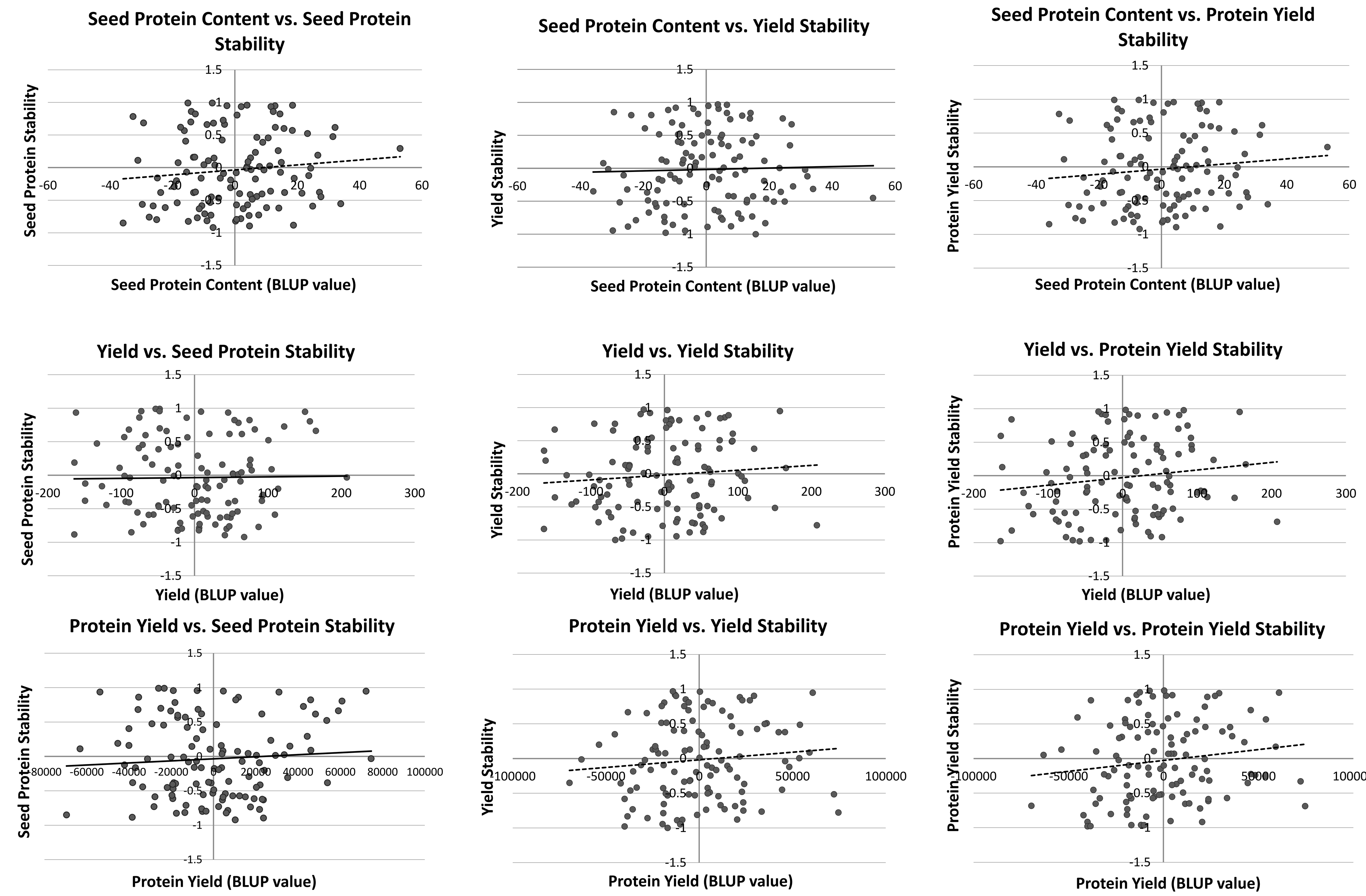

Figure 3. Scatter plots indicating the correlations between traits (protein, protein yield, and yield) and the Eberhart-Russell regression stability index of each trait[3]. None of the correlations were statistically significant.

CONCLUSION

The lack of significant correlation between measures of protein and the stability indices suggests that high protein content is equally stable across environments as low protein content in these breeding lines. Thus, the production of soybeans with high protein yield may be a reliable source of dietary protein in variable and constrained environments. However, the present study is limited in the range of environments and breeding material. This may be evidenced by the lack of significant correlation between yield and yield stability, which is different from what has been found in previous studies[2]. A next step in determining the relative stability of high protein cultivars would be to continue the study for several years and broaden the range of environments considered. Additionally, we can apply alternative methods to measure environmental stability which include deviation from the Eberhart-Russell regression[3].

LITERATURE CITED

1 International Institute of Tropical Agriculture. Crops, Soybean. http://www.iita.org/soybean
2 Rincker et al. 2014. Crop Science. 54:1-14.
3 Eberhart and Russell. 1966. Crop science. 6: 36-40.
4 SAS Institute Inc. (Computer software) 2015. http://www.sas.com/en_us/home.html

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